

Application No. 09/500,994
Amendment filed November 5, 2003
Reply to Office Action August 6, 2003

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REMARKS

Claims 17-28 are pending, with claim 17 being in independent form. By the present amendment, claim 17 has been amended and claims 24-28 have been added without adding new matter.

In the Office Action, the specification and drawings are objected to for improperly introducing new matter. In particular, the Examiner contends that the original disclosure does not support a ground plug being connected to a connector which is then connected to a source of the MOS transistor. Claim 23 is rejected for failing to comply with the written description requirement on similar grounds. Applicants respectfully disagree with the Examiner's position for the following reasons.

Originally filed claim 9 (now canceled) recites "said transistor is a MOS transistor and said ground connection is a source connection". MPEP § 2163.06 III states that if an application as originally filed contains a claim disclosing material not disclosed in the remainder of the specification, the applicant may amend the specification to include the claimed subject matter (citing In re Benno, 768 F.2d 1340 (Fed. Cir 1985)). Applicants believe the text added to the specification and the interconnection between the metal plug and the source contact shown in FIG. 4 accurately reflect the originally claimed subject matter without improperly adding new matter. Moreover, claim 23 is believed to be fully supported by the originally filed application as well. Accordingly, Applicants respectfully request the Examiner to reconsider and withdraw the new matter objections and the rejection of claim 23 for failing to comply with the written disclosure requirement.

Claim 20 (recited as claim 4 in the Action) stands rejected for indefiniteness. In particular, the Examiner contends that the term "high", recited in the phrase "high frequency device" is indefinite. Applicants respectfully disagree. The Merriam-Webster Dictionary includes a radio-frequency table defining high frequencies as being above about three megahertz. Merriam-Webster Dictionary (10 ed.). Applicants use of the term in the specification is consistent with this plain meaning.

For example, Applicants describe that an "operating frequency for modern telecommunication electronics range from several hundred megahertz up into the gigahertz region". P. 1, ll. 8-9. Also, Applicants describe that for "applications like wireless handy phones . . . the operating frequency is in the 1-3 GHz range". P. 1, ll. 18-21. Applicants then describe that the "dominating technology in this field is GaAs-based, but silicon-based circuits . . . main advantage is the considerably lower price, and its disadvantage the more limited performance at high frequencies". P. 1, ll. 22-26

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(emphasis added). Accordingly, Applicants believe the phrase "high frequency device" is sufficiently definite, and respectfully request the Examiner to reconsider and withdraw the indefiniteness rejection.

Turning to the art rejections, claims 17-22 are rejected for obviousness over U.S. Patent No. 5,240,867 to Suzuki et al. ("Suzuki"). No art rejections are raised against claim 23 in the Action. The amendment is believed to overcome the obviousness rejection for the following reasons.

In accordance with the MPEP, three criteria must be met to establish a prima facie case of obviousness. First, the cited document must describe or suggest all of the claim features. Second, there must be some suggestion or motivation, either in the cited document itself or in the knowledge generally available to one of ordinary skill in the art, to have modified the teachings of the cited document to reach the claimed subject matter. Third, there must have been a reasonable expectation that the teachings of the cited document could have been successfully modified to yield the claimed invention.

The rejections raised in the Action cannot stand at least because the cited document does not describe or suggest all of the claim features. Motivations to modify the teachings of the cited document and reasonable expectations of those modifications being successful would also be absent, but it should be sufficient to point out the absent features.

For example, claim 17 has been amended to recite, among other things, "an isolation means extends through said at least one layer down into the substrate and is arranged between the semiconductor device and the metal plug for delimiting the semiconductor device". Support for the amendment may be found throughout the specification, and in particular on p. 5, ll. 27-30, p. 7, ll. 10-13, and in the figures. For example, the deep isolation trenches 105 shown in the figures extend from the surface 106 of a device into the substrate 102, and serve to delimit the device by providing isolation, e.g., from the ground contact via the metal plug 121.

Suzuki does not describe or suggest the recited isolation means extending through at least one layer of the device down into the substrate. For example, the isolation trench structures IS1 and IS2, described by Suzuki as isolating the active region Tr of the transistor shown in FIG. 5, do not extend down into the substrate 61 as claim 17 requires. Instead the trench structures IS1 and IS2 extend down only into the p⁺ epitaxial layer 63 of Suzuki's structure. See col. 6, ll. 12-51, and FIG. 5.

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Indeed, Suzuki teaches away from an arrangement in which the isolation trench structures IS1 and IS2 would extend down into the substrate 61. Suzuki describes that the p-n junction between the epitaxial layer 63 and the substrate 61 should always be reversed biased such that current entering the metallized layer 62 is prevented from entering into the collector region 64a of the transistor. Extending the isolation trench structures IS1 and IS2 down into the substrate 61 would isolate the portion of the epitaxial layer 63 below the active region Tr of the transistor from the contact region 65, thus preventing the reverse bias between the layers from being maintained.

Suzuki also does not describe or suggest the feature of the isolation means being arranged between the semiconductor device and the metal plug for delimiting the semiconductor device. Support for this feature may be found in FIG. 1, and the associated text describing the relationship between the metal plug 121 and the deep trench 105 isolation means shown in the figure. As described above, Suzuki's isolation trench structures IS1 and IS2 serve to isolate only the active region Tr of the transistor. Other portions of Suzuki's transistor, e.g., the contact region 65, lie outside the isolation trench structures IS1 and IS2, and thus the trench structures IS1 and IS2 cannot be said to be arranged between the conductive region 73 and the transistor, as claim 17 requires.

Accordingly, because Suzuki does not describe or suggest all of the features of claim 17, Applicants believe the claim to be novel and inventive over the cited document, and respectfully request the Examiner to reconsider and withdraw the obviousness rejection.

In addition to the above, claim 25 recites that the metal plug is comprised of an etched hole filled in its entirety with metallic material. Support for the claim may be found on p. 6, ll. 29-31 of the written description. Suzuki does not describe or suggest this feature either. Instead, Suzuki describes a U-groove 71 that is covered by an oxide layer 72 and is filled with an n⁺-type polysilicon to form a conductive region 73 which extends from the substrate 61 to the surface of the chip 60. Col. 6, ll. 52-59.

Moreover, Suzuki's arrangement would discourage a person skilled in the art from filling the U-groove 71 in its entirety with a metallic material, as claim 25 requires. Doing so would result in a short-circuit between the substrate 61 (connected to highest voltage potential Vcc) and the epitaxial layer 63 (connected to the lowest voltage potential Vee), causing catastrophic damage to the device. Accordingly, independent claim 25 is novel and inventive over Suzuki for this reason as well.

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Claim 26 recites a highly-doped plug contact region in said substrate at a lower tip of said metal plug. Claim 27 adds that the substrate is doped with a first doping type and the plug contact region is a doped region of the substrate. The doped region of claim 27 is doped with the first doping type and has a higher doping concentration than that of the substrate outside said doped region. Support for these claims may be found on p. 6, ll. 28-29 of the written description and in FIG. 1, which shows an exemplary highly-doped plug contact region 122 having a higher doping concentration p^{++} than the doping concentration p^+ of the substrate 102 outside the doped region 122. In contrast, Suzuki's substrate 61 has a homogeneous n^+ doping profile. Accordingly, dependent claims 26 and 27 are considered to be novel and inventive over Suzuki for this reason as well.

For the foregoing reasons, Applicants believe the application is in condition for allowance, and respectfully request Notice thereof at an early date. If any questions remain, the Examiner is invited to contact the undersigned at the below-listed telephone number.

Respectfully submitted,

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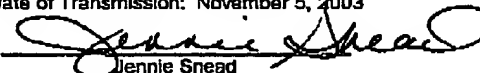
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